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(54) **MULTIFUNCTIONAL KEYBOARD FOR A MOBILE COMMUNICATION DEVICE AND METHOD OF OPERATING THE SAME**

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H04M 1/00 (2006.01)
H04M 3/00 (2006.01)

(52) **U.S. Cl.** **379/368**; 379/52; 379/356.01; 379/374.02; 400/485; 400/486; 400/489; 345/168; 345/169

(58) **Field of Classification Search** 379/52, 379/356.01, 368, 374.02, 433.07; 400/485, 400/486, 489; 345/168, 169
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,430,639	A	2/1984	Bennett et al.
4,503,288	A	3/1985	Kessler
D278,341	S	4/1985	Scheid
4,613,247	A	9/1986	McGunnigle
D293,241	S	12/1987	Wan et al.
4,799,254	A	1/1989	Dayton et al.
4,888,815	A	12/1989	Ahlemeyer et al.
4,999,795	A	3/1991	Lapeyre
5,184,830	A	2/1993	Okada et al.
5,217,295	A	6/1993	Tortola et al.
5,334,976	A	8/1994	Wang
5,336,002	A	8/1994	Russo
5,367,298	A	11/1994	Axhelm
5,375,165	A	12/1994	Haber et al.
D357,253	S	4/1995	Wong
5,410,141	A	4/1995	Koenck et al.
5,426,449	A	6/1995	Danziger
5,436,954	A	7/1995	Nishiyama et al.

(Continued)

FOREIGN PATENT DOCUMENTS

EP	0760291	3/1997
EP	0760291 A2	3/1997

(Continued)

OTHER PUBLICATIONS

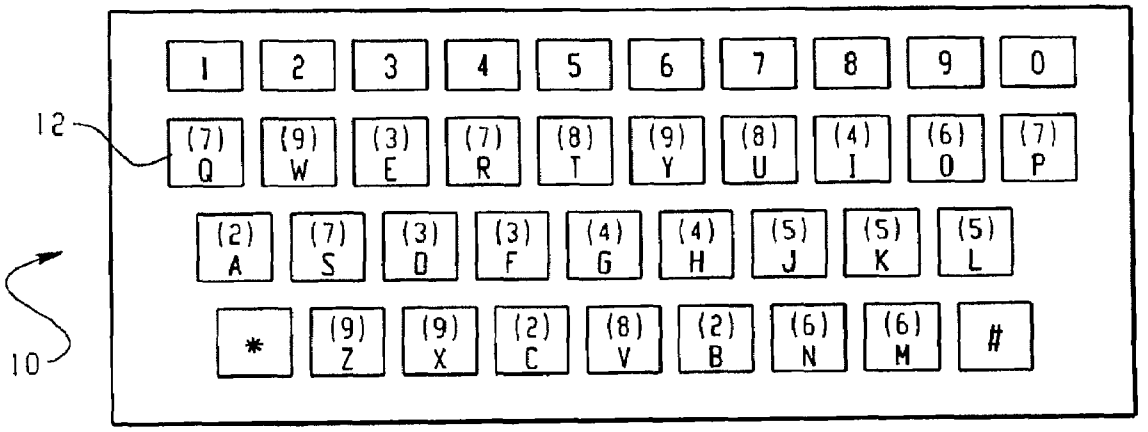
Nokia: User's Manual, 9357109 Issue 2 EN, Jun. 7, 1998 (126 pages).

Primary Examiner — Tuan Pham

(57) **ABSTRACT**

An apparatus and method for telephony tone signal and character code generation for QWERTY keyboards includes a QWERTY style keyboard, a processor and a keyboard mode control software module. The QWERTY style keyboard has a plurality of letter keys, wherein each letter key is configured to generate a unique input signal. The processor is coupled to the keyboard and is configured to convert each unique input signal generated by the letter keys into a character code and/or a telephony tone signal. The keyboard mode control software module operates on the processor, and controls whether the processor converts the unique input signals from the letter keys into character codes or telephony tone signals.

13 Claims, 7 Drawing Sheets



U.S. PATENT DOCUMENTS

5,457,454	A		10/1995	Sugano
5,500,643	A		3/1996	Grant
5,581,593	A		12/1996	Engelke et al.
5,606,712	A		2/1997	Hidaka
5,611,031	A		3/1997	Hertzfeld et al.
5,660,488	A		8/1997	Miller
D383,756	S		9/1997	Henderson et al.
5,672,108	A		9/1997	Lam et al.
D386,497	S		11/1997	Huslig et al.
5,737,394	A		4/1998	Anderson et al.
D397,369	S		8/1998	Rissman
D397,728	S		9/1998	Yuen et al.
D399,537	S		10/1998	Chi et al.
5,818,437	A		10/1998	Grover et al.
5,825,353	A		10/1998	Will
5,841,374	A		11/1998	Abraham
D403,362	S		12/1998	Fai
5,848,356	A	*	12/1998	Jambhekar et al. 455/403
5,893,798	A		4/1999	Stambolic et al.
5,920,308	A		7/1999	Kim
5,931,873	A		8/1999	Cisar
5,952,942	A		9/1999	Balakrishnan et al.
5,963,197	A		10/1999	Bacon et al.
5,974,238	A		10/1999	Chase, Jr.
5,982,520	A		11/1999	Weiser et al.
5,995,026	A		11/1999	Sellers
6,006,351	A		12/1999	Peretz et al.
6,014,429	A		1/2000	LaPorta et al.
6,023,779	A		2/2000	Fullam et al.
6,046,732	A		4/2000	Nishimoto
6,047,047	A		4/2000	Aldridge et al.
6,047,196	A		4/2000	Makela et al.
6,049,697	A	*	4/2000	Scozzarella et al. 340/7.31
6,052,070	A		4/2000	Kivela et al.
6,081,584	A		6/2000	Hidaka
6,094,197	A		7/2000	Buxton et al.
6,102,594	A		8/2000	Strom
6,107,994	A		8/2000	Harada et al.
6,107,997	A		8/2000	Ure
6,148,261	A		11/2000	Obradovich et al.
6,157,323	A		12/2000	Tso et al.
6,212,412	B1		4/2001	Rogers et al.
6,218,966	B1		4/2001	Goodwin et al.
6,241,406	B1		6/2001	Yan
6,243,789	B1		6/2001	Hasbun et al.
6,297,795	B1		10/2001	Kato et al.
6,429,855	B2		8/2002	Pabon et al.
6,662,020	B1		12/2003	Aaro et al.
6,690,417	B1		2/2004	Yoshida et al.
6,965,372	B1		11/2005	Woods

FOREIGN PATENT DOCUMENTS

EP	0898222		2/1999
EP	0898222	A1	2/1999
WO	99/37025	A1	7/1999
WO	WO9937025		7/1999
WO	00/30381	A1	5/2000
WO	WO0030381		5/2000

* cited by examiner

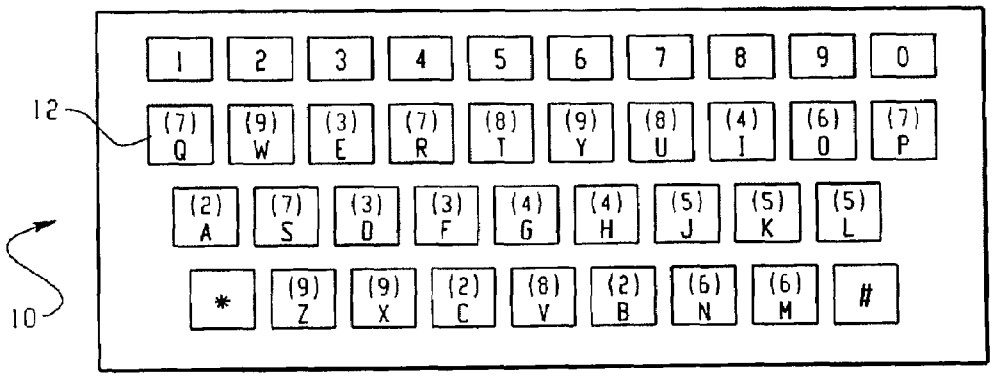

1 2 3 4 5 6 7 8 9 0
(7) Q (9) W (3) E (7) R (8) T (9) Y (8) U (4) I (6) O (7) P
(2) A (7) S (3) D (3) F (4) G (4) H (5) J (5) K (5) L
* (9) Z (9) X (2) C (8) V (2) B (6) N (6) M #
12
10

Fig. 1

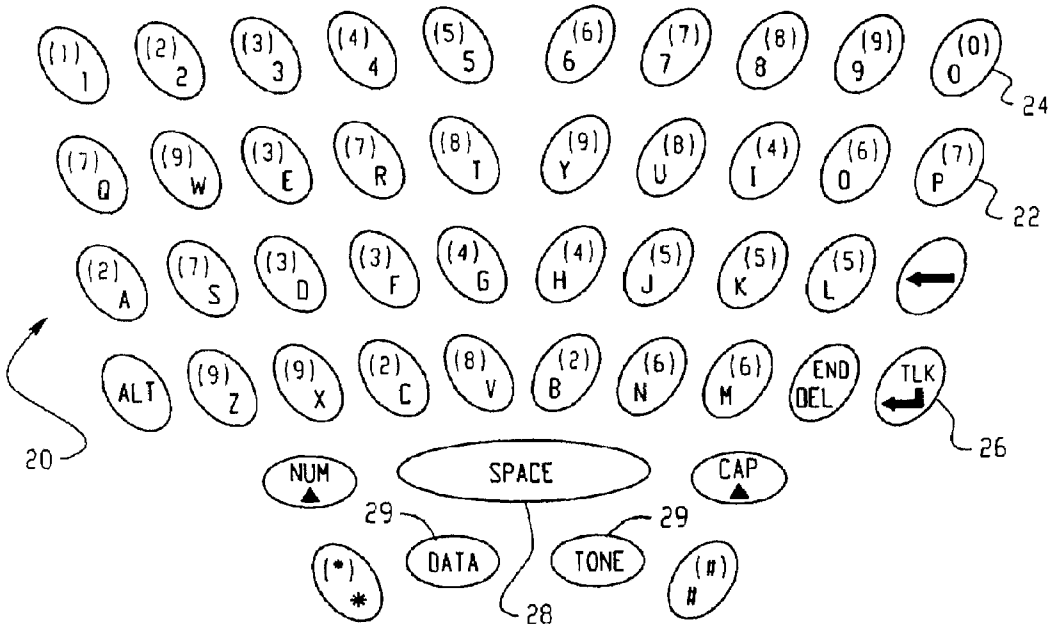

(1) 1 (2) 2 (3) 3 (4) 4 (5) 5 (6) 6 (7) 7 (8) 8 (9) 9 (0) 0
24
(7) Q (9) W (3) E (7) R (8) T (9) Y (8) U (4) I (6) O (7) P
22
(2) A (7) S (3) D (3) F (4) G (4) H (5) J (5) K (5) L
ALT (9) Z (9) X (2) C (8) V (2) B (6) N (6) M END DEL TLK
26
20
NUM SPACE CAP
29 29
(*) * DATA TONE (#) #
28

Fig. 2

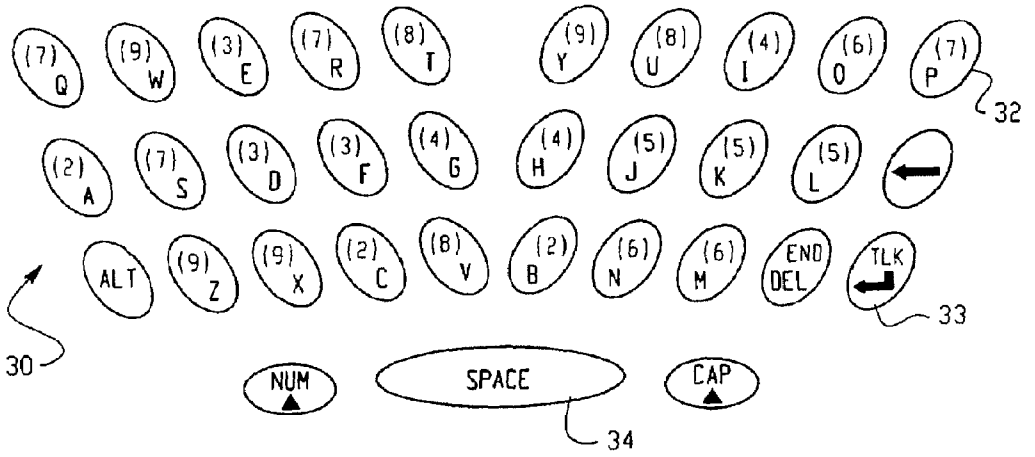

(7) Q
(9) W
(3) E
(7) R
(8) T
(9) Y
(8) U
(4) I
(6) O
(7) P
32
(2) A
(7) S
(3) D
(3) F
(4) G
(4) H
(5) J
(5) K
(5) L
ALT
(9) Z
(9) X
(2) C
(8) V
(2) B
(6) N
(6) M
END DEL
TLK
33
30
NUM
SPACE
CAP
34

Fig. 3a

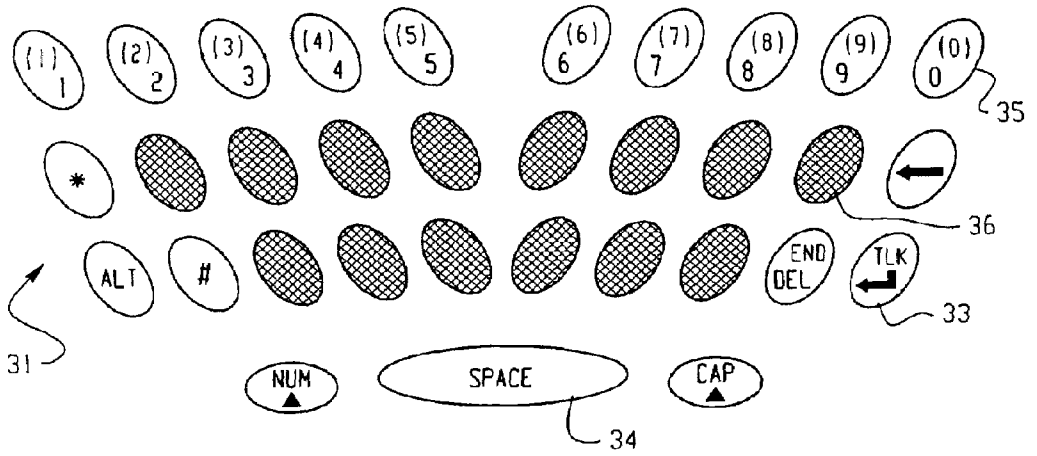

(1) 1
(2) 2
(3) 3
(4) 4
(5) 5
(6) 6
(7) 7
(8) 8
(9) 9
(0) 0
35
*
36
ALT
#
END DEL
TLK
33
31
NUM
SPACE
CAP
34

Fig. 3b

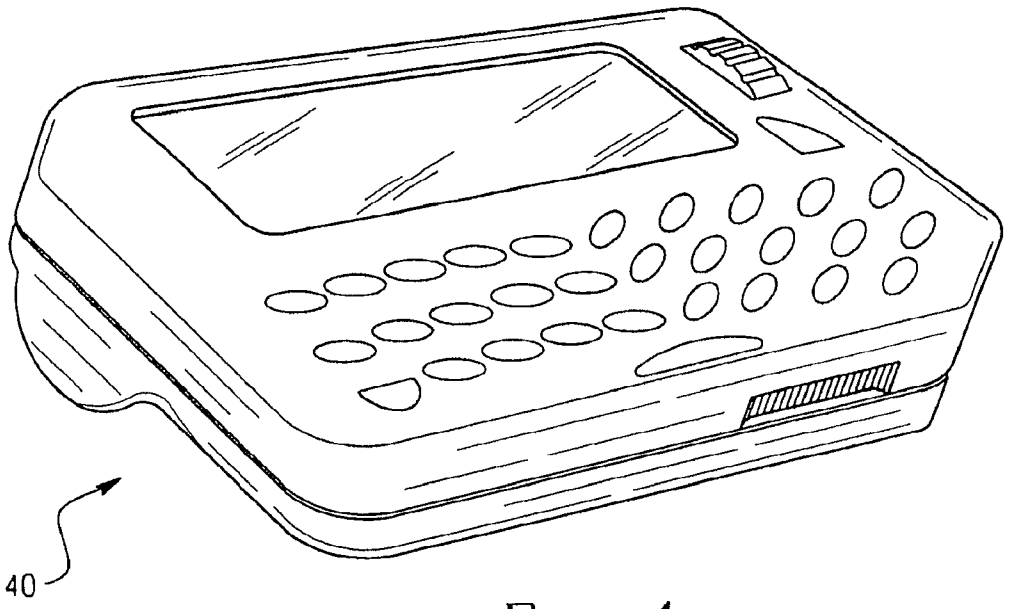


Fig. 4

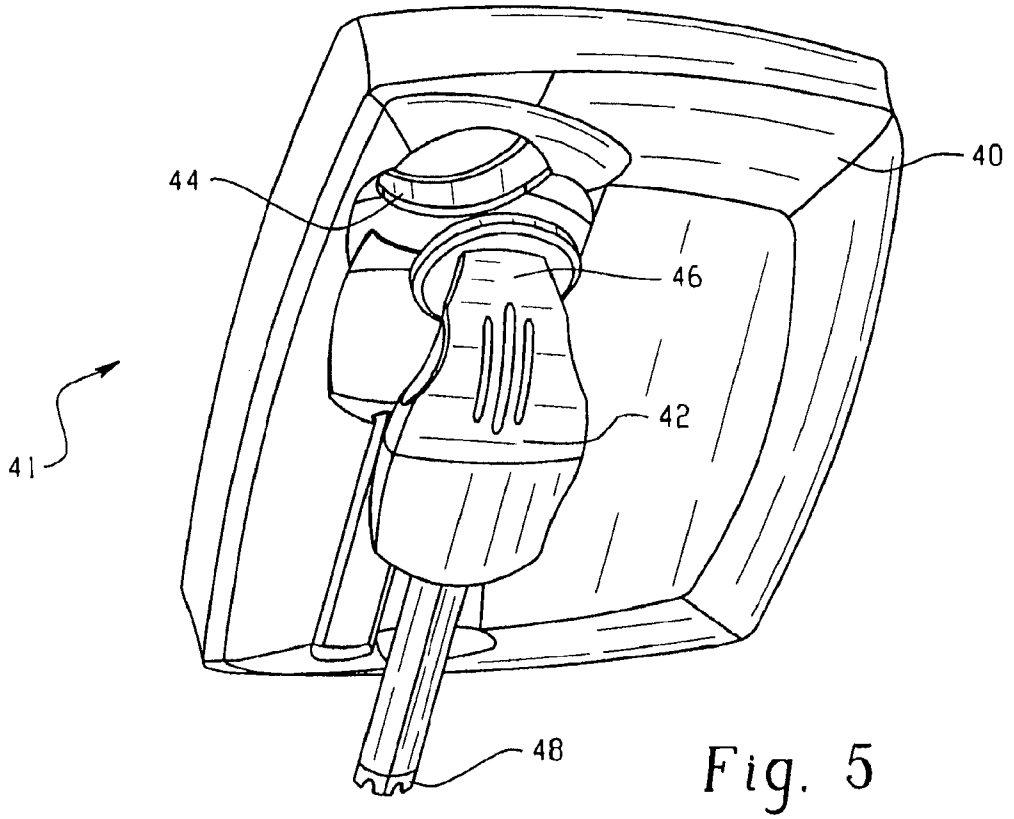


Fig. 5

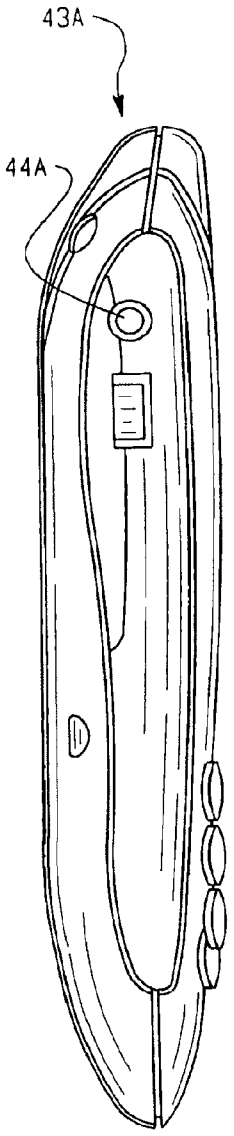


Fig. 5b

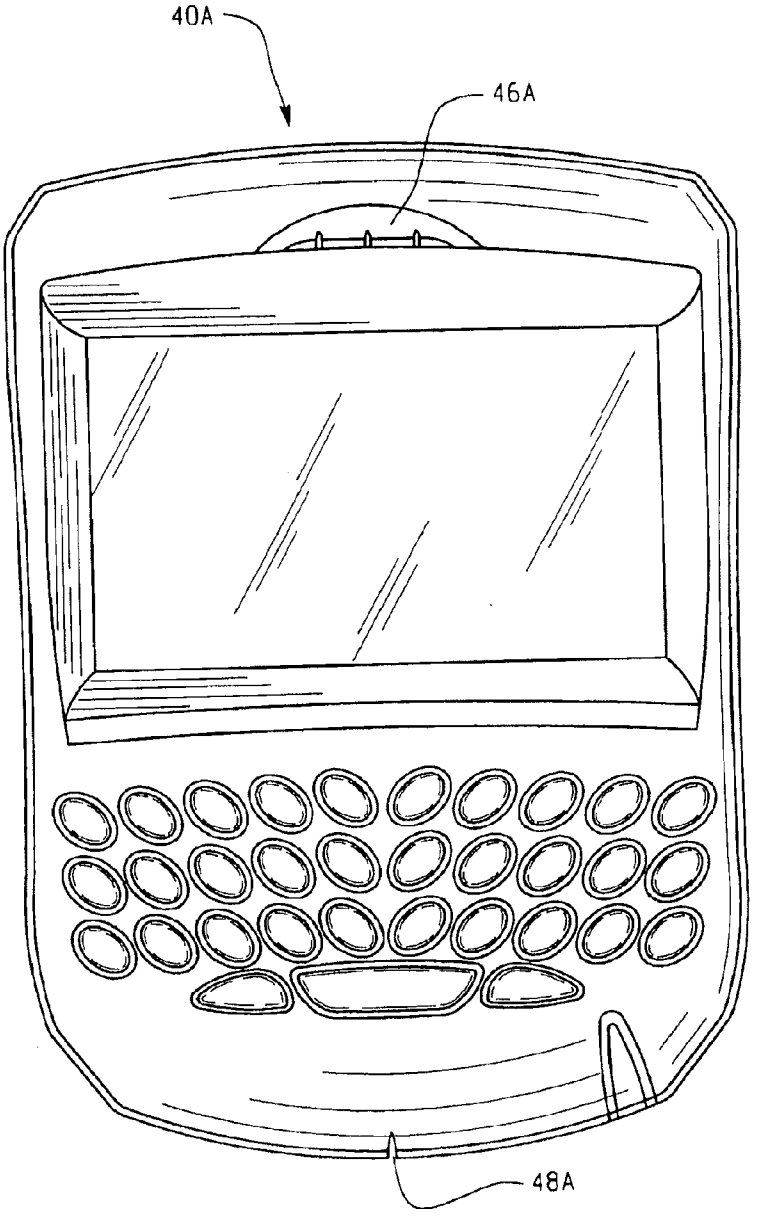


Fig. 5a

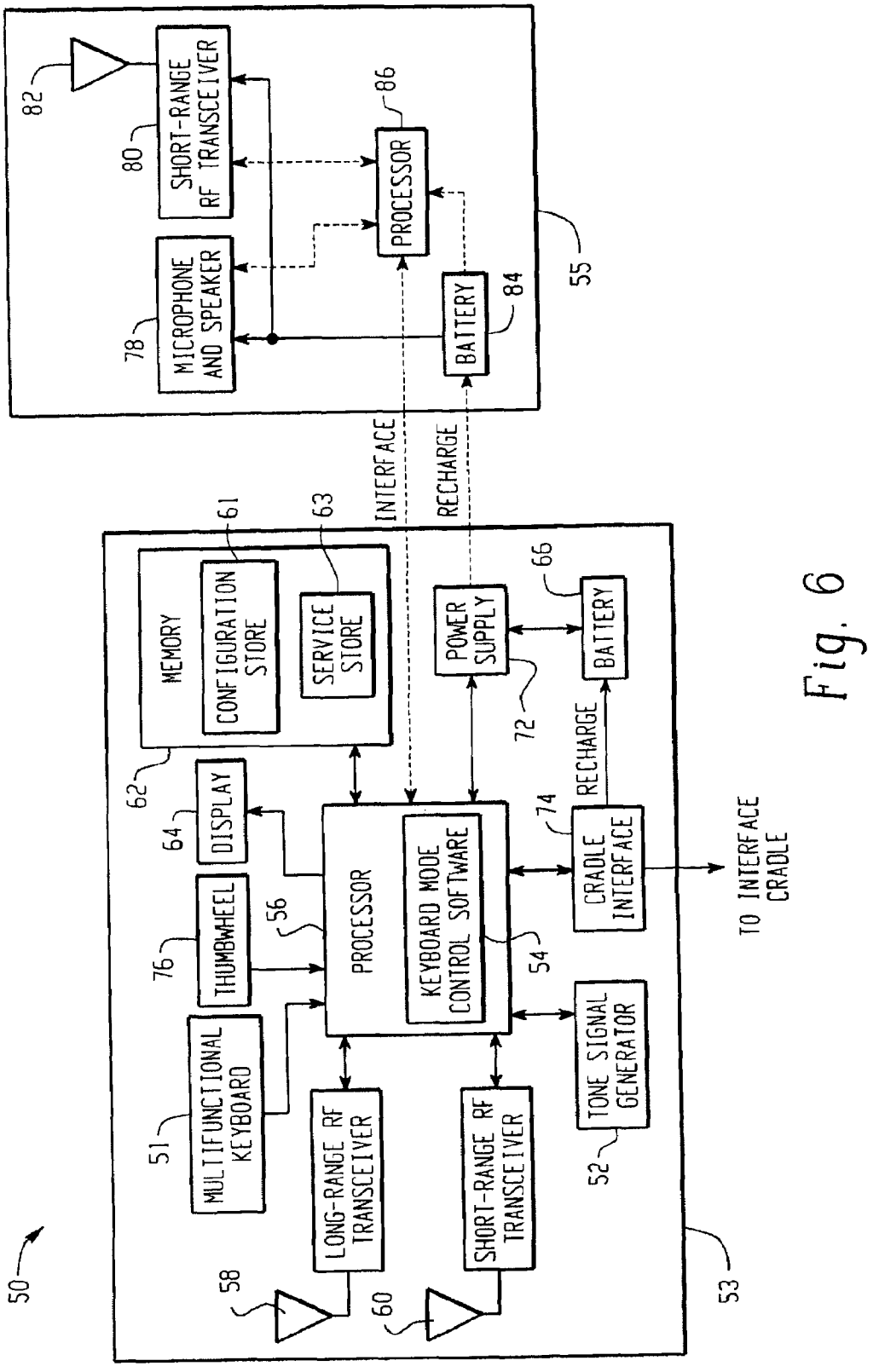

50
51
MULTIFUNCTIONAL KEYBOARD
52
TONE SIGNAL GENERATOR
53
54
KEYBOARD MODE CONTROL SOFTWARE
55
56
58
60
61
62
63
64
66
72
74
76
78
80
82
84
86
MEMORY
CONFIGURATION STORE
SERVICE STORE
DISPLAY
THUMBWHEEL
PROCESSOR
LONG-RANGE RF TRANSCEIVER
SHORT-RANGE RF TRANSCEIVER
POWER SUPPLY
BATTERY
RECHARGE
CRADLE INTERFACE
TO INTERFACE CRADLE
INTERFACE
RECHARGE
SHORT-RANGE RF TRANSCEIVER
MICROPHONE AND SPEAKER
PROCESSOR
BATTERY

Fig. 6

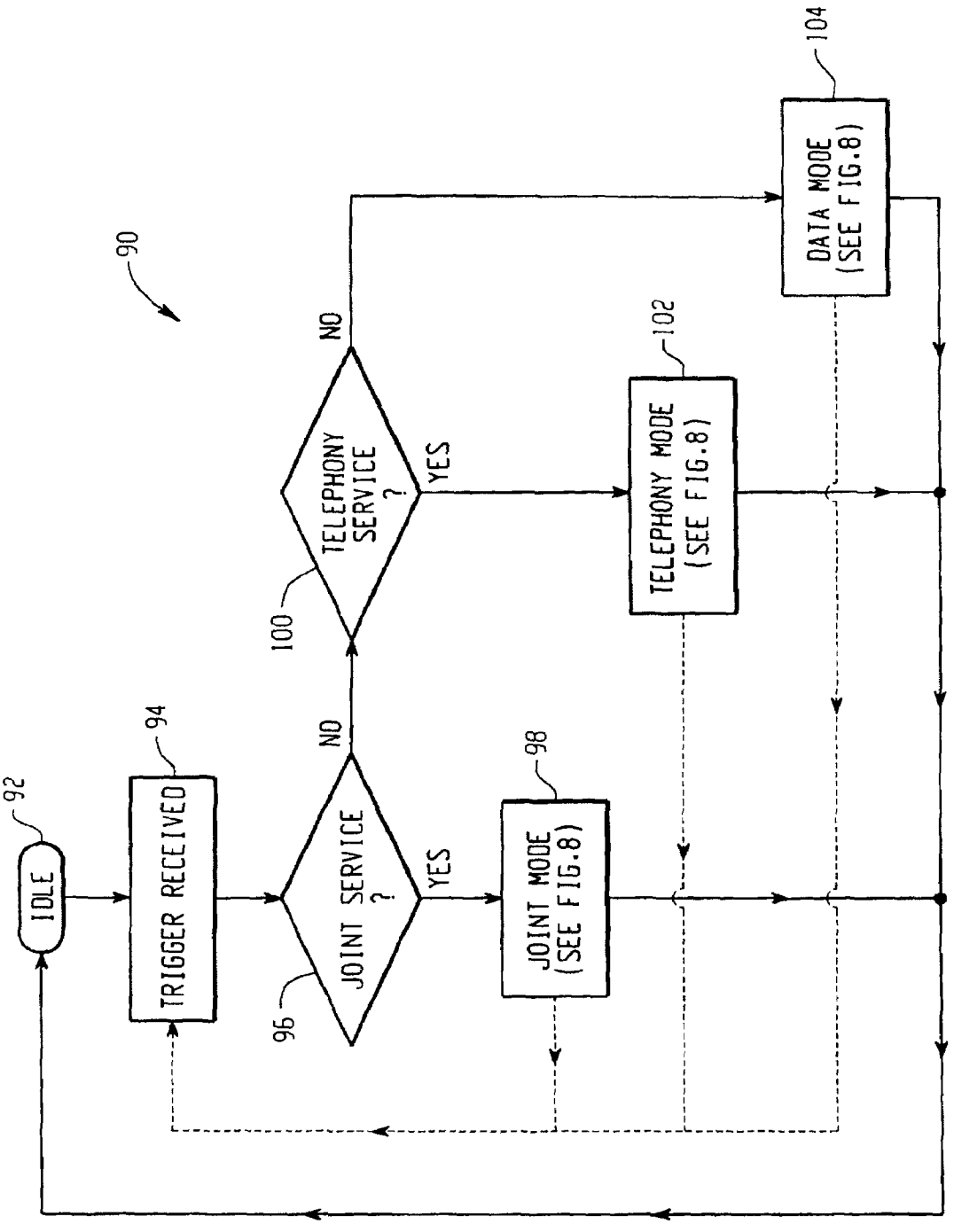

90
IDLE
92
TRIGGER RECEIVED
94
JOINT SERVICE ?
96
NO
YES
JOINT MODE (SEE FIG.8)
98
TELEPHONY SERVICE ?
100
NO
YES
TELEPHONY MODE (SEE FIG.8)
102
DATA MODE (SEE FIG.8)
104

Fig. 7

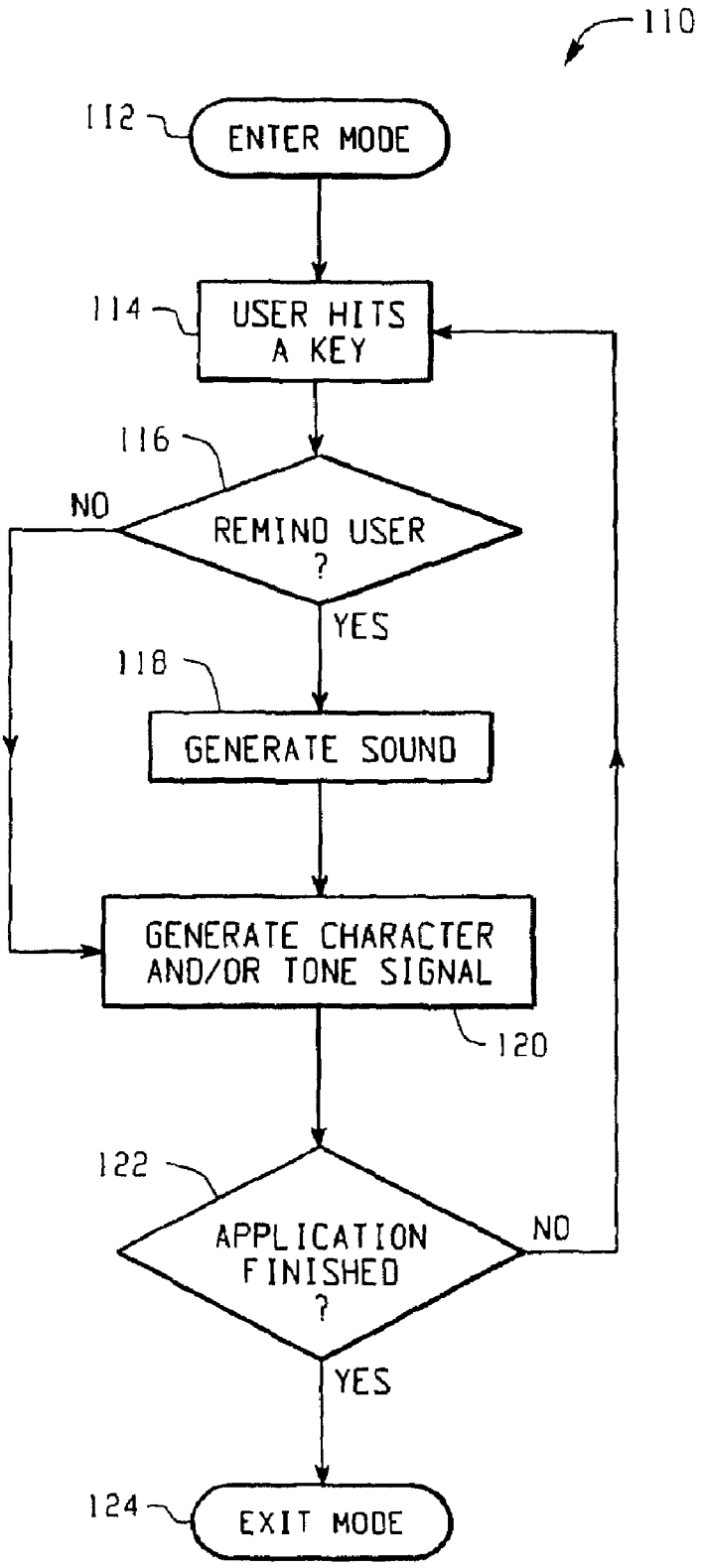

110
112
ENTER MODE
114
USER HITS A KEY
116
NO
REMIND USER ?
YES
118
GENERATE SOUND
GENERATE CHARACTER AND/OR TONE SIGNAL
120
122
APPLICATION FINISHED ?
NO
YES
124
EXIT MODE

Fig. 8

MULTIFUNCTIONAL KEYBOARD FOR A MOBILE COMMUNICATION DEVICE AND METHOD OF OPERATING THE SAME

CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation of the application titled, "Multifunctional Keyboard For A Mobile Communication Device And Method Of Operating The Same," application Ser. No. 10/004,001, filed Nov. 1, 2001, which is related to the following prior application: "Apparatus And Method For Telephony Tone Signals and Character Codes Generation For QWERTY Keyboards Or The Like," U.S. Provisional Application No. 60/246,321, filed Nov. 7, 2000. This prior application, including the entire written description and drawing figures, is hereby incorporated into the present application by reference.

BACKGROUND

1. Field of the Invention

This invention relates generally to the field of keyboard user interfaces. In particular, the invention provides a multifunctional keyboard for a mobile communication device and method of operating the same.

2. Description of the Related Art

Advances in communication technology have created a convergence between the fields of data and telephony communications. Traditional communication devices, however, typically include two separate interfaces; one for telephony communication, and one for data communication. Other known communication devices utilize the limited character mapping available on a typical telephone keypad to perform data entry functions. For instance, current telephone keypads map keys to characters on a one-to-many basis: 12 keys (1, 2, 3, 4, 5, 6, 7, 8, 9, *, 0, #) correspond to 26 characters (ABC, DEF, GHI, JKL, MNO, PQRS, TUV, WXYZ). In addition, most such telephone keypads do not include many of the characters from the American Standard Code for Information Interchange (ASCII) character code. In other known communication devices, including many cellular phones, data may be entered with a typical telephone keypad by repeatedly pressing a key to cycle through a number of associated character codes. For instance, repeatedly pressing the keypad key "2" on a typical cellular phone may cycle through the characters A, B, C, a, b, c, and 2.

SUMMARY

A multifunctional keyboard for a mobile communication device includes a keyboard, a processor and a keyboard mode control software module. The keyboard has a plurality of letter keys, wherein each letter key is configured to generate a keyboard output signal. The processor is coupled to the keyboard and is configured to convert each keyboard output signal generated by the letter keys into a character code and/or a telephony tone signal. The keyboard mode control software module operates on the processor, and controls whether the processor converts the keyboard output signals from the letter keys into character codes or telephony tone signals.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an exemplary multifunctional keyboard having keys that are mapped to both telephony tone signals and character code signals;

FIG. **2** is another exemplary multifunctional keyboard in which the keys are arranged for optimal use with a hand-held device;

FIGS. **3***a* and **3***b* illustrate an additional exemplary multifunctional keyboard for a communication device in which a plurality of character entry keys can function as either letter entry keys or number entry keys;

FIG. **4** is a top perspective view of a mobile communication device utilizing a multifunctional keyboard;

FIG. **5** is a bottom perspective view of the mobile communication device shown in FIG. **4**;

FIG. **5***a* is a top view of an additional mobile communication device utilizing a multifunctional keyboard;

FIG. **5***b* is a side view of the additional mobile communication device shown in FIG. **5***a;*

FIG. **6** is a block diagram of an exemplary mobile communication device utilizing a multifunctional keyboard;

FIG. **7** is a flow diagram illustrating an exemplary method for controlling the operational mode of the multifunctional keyboard in a communication device; and

FIG. **8** is a flow diagram illustrating the modes of operation for the multifunctional keyboard.

DETAILED DESCRIPTION

Referring now to the drawing figures, FIG. **1** is an exemplary multifunctional keyboard **10** having keys **12** that are mapped to both telephony tone signals and character code signals. The multifunctional keyboard **10** is preferably a QWERTY style keyboard in which each of the letter keys **12** also corresponds to a number, although a different keyboard style could be used such as a Dvorak or AZERTY keyboard. The number corresponding to a letter key **12** on the multifunctional keyboard **10** is preferably based on the number/character correspondence on a traditional telephone keypad. For instance, the number two (2) on a traditional telephone keypad corresponds to all of the letters A, B and C. Similarly, the letter keys A, B and C on the multifunctional keyboard **10** each correspond to the number two (2).

The multifunctional keyboard **10** is multifunctional in the sense that it operates in at least two modes: a telephony mode and a data mode. In the telephony mode, a key **12** pressed on the multifunctional keyboard results in a telephony tone signal for communicating with a voice communication network. The telephony tone signal may, for example, be a Dual Tone Multi Frequency (DTMF) signal commonly used for dialing a phone number in voice communication networks. In the data mode, pressing the same key **12** on the multifunctional keyboard **10** will result in the generation of a character code, such as an American Standard Code for Information Interchange (ASCII) character code.

In a preferred embodiment, the multifunctional keyboard **10** may also operate in a joint mode. In the joint mode of operation, depressing keys on the multifunctional keyboard **10** results in the simultaneous generation of both telephony tone signals and character codes. For example, pushing the Q key may result in both an ASCII code for the letter Q and a DTMF signal representing the number seven (7).

FIG. **2** is another exemplary multifunctional keyboard **20** in which the keys are arranged for optimal use with a hand-held mobile communication device. The keys of the multifunctional keyboard **20** preferably comprise a QWERTY style keyboard, although other keyboard styles could be utilized, having a plurality of letter keys **22**, a plurality of number keys **24**, specialized keys **26** and a space bar **28**. Each of the letter **22** and number **24** keys preferably correspond to a character code while the keyboard **20** is in data (or joint)

mode, and correspond to a telephony tone signal while the keyboard **20** is in telephony (or joint) mode. In addition, one or more of the specialized keys **26** may have functions that vary depending upon the mode of the multifunctional keyboard **20**. For instance, one specialized key **26** may perform a "line feed" function while the keyboard **20** is in data mode, and a "talk" function while the keyboard **20** is in telephony mode. In addition, the multifunctional keyboard **20** may include one or more mode keys **29** that switch the keyboard **20** from one operational mode (telephony, data or joint) to another.

FIGS. **3***a* and **3***b* illustrate an additional exemplary multifunctional keyboard **30**, **31** for a communication device in which a plurality of character entry keys can function as either letter entry keys **32** or number entry keys **35**. Similar to the multifunctional keyboards **10**, **20** described above with reference to FIGS. **1** and **2**, this multifunctional keyboard **30**, **31** may operate in telephony mode, data mode, and possibly joint mode. In addition, however, this multifunctional keyboard **30**, **31** utilizes less keys by providing a letter entry mode, shown in FIG. **3***a*, and a number entry mode, shown in FIG. **3***b*. While in letter entry mode, the keyboard **30** preferably comprises a QWERTY style keyboard **30**, although other keyboard styles may be utilized, having a plurality of letter entry keys **32**, specialized keys **33** and a space bar **34**. If a letter entry key **32** is pressed while the keyboard **30** is in letter entry mode, a telephony tone signal and/or a character code corresponding to the letter on the key may be generated, depending upon the operational mode (telephony, data or joint) of the keyboard **30**. When the keyboard **31** is in number entry mode, however, a number of the keys are remapped to provide a numerical keypad, preferably comprising a plurality of number entry keys **35**, specialized keys **33**, a space bar **34** and a plurality of non-functional keys **36**. If a number entry key **35** is pressed while the keyboard **31** is in number entry mode, a telephone tone signal and/or a character code corresponding to the number on (or represented by) the key may be generated, depending upon the operational mode of the keyboard **31** (telephony, data or joint).

Preferably, the character entry keys that function as both number entry and letter entry keys, depending upon the entry mode, have both a number and a letter printed on the key. For example, the "Q" key shown in FIG. **3***a* and the corresponding "1" key shown in FIG. **3***b* would preferably have both a "Q" and a "1" printed on the key. The numbers shown in parentheses represent the telephony tone signals corresponding to the letter or number character, and would preferably not be printed on the key. It should be understood, however, that other printing arrangements are contemplated. In addition, the keyboard **30**, **31**, or the communication device utilizing the keyboard **30**, **31**, preferably includes some means to indicate whether the keyboard is in number or letter entry mode. For example, when the keyboard **30**, **31** is in one of the letter or number entry modes, an icon may appear on a display, a particular audible tone may sound when a key is pressed, an LED may light, or some other indication means may be activated.

In an alternative embodiment, the multifunctional keyboard **30**, **31** may be provided in conjunction with a displayed software user interface. For instance, the multifunctional keyboard **30**, **31** may by represented on a display, such as a liquid crystal display ("LCD"). In this embodiment, touching the LCD within the boundaries of a drawn key representation is equivalent to pressing a key on the keyboard **30**, **31**. In addition, an LCD embodiment of the multifunctional keyboard **30**, **31** may include a function in which the symbols displayed on each drawn key change with the operational mode to emphasize the particular telephony signal and/or character code to be generated by each key.

FIG. **4** is a top perspective view of a mobile communication device **40** utilizing a multifunctional keyboard **30**. The keys of the multifunctional keyboard **30** are preferably uniformly distributed across the device **40** such that approximately half of the QWERTY keys are positioned on the left hand side of the device **40**, and the remaining half of the QWERTY keys are positioned on the right hand side of the device **40**. In addition, the QWERTY keys are preferably tilted at angles to facilitate easy thumb typing while the mobile device is held between the hands of a mobile device user.

FIG. **5** is a bottom perspective view **41** of the mobile communication device **40** shown in FIG. **4**. The communication device **40** preferably includes an ear bud **42** that is detachably fitted within a cavity **44** in the device housing. The ear bud **42** preferably includes a speaker portion **46** proportioned to fit within the ear of a communication device user and a microphone portion **48** that extends towards the user's mouth. When fitted into the device user's ear, the ear bud **42** may, for example, be used to establish voice communication through the mobile communication device **40**. It should be understood, however, that the mobile communication device **40** is not limited to embodiments having a detachable ear bud **42**. In other embodiments, such as the embodiment described below with reference to FIGS. **5***a* and **5***b*, voice communication may be enabled with other means, such as a speaker and microphone fixedly mounted on the device or an ear piece and microphone connected to the device **40** through an electrical terminal or jack.

FIG. **5***a* is a top view of an additional mobile communication device **40**A utilizing a multifunctional keyboard **30**. The communication device **40**A preferably includes a speaker **46**A and a microphone **48**A fixedly mounted on the device. When positioned near the device user's head, the speaker **46**A and the microphone **48**A may, for example, be used to establish a voice communication though the communication device **40**A.

FIG. **5***b* is a side view **42**A of the additional mobile communication device **40**A shown in FIG. **5***a*. The communication device **40**A preferably includes a jack **44**A for connecting a headset having an earpiece and microphone to the device **40**.

FIG. **6** is a block diagram of an exemplary mobile communication device **50** utilizing a multifunctional keyboard **51**. The device **50** preferably includes a main module **53** and an ear bud module **55**. The multifunctional keyboard **51** is included in the main module **53** along with a tone signal generation circuit **52**, a keyboard mode control software module **54** operating on a processor **56**, and a memory device **62** having a configuration store **61** and a service store **63**. In an alternative embodiment, however, the processor **56** may be replaced by an alternative processing unit, such as a field programmable gate array ("FPGA") or a software interpreter module.

The processor **56** receives keyboard output signals from the multifunctional keyboard **51** and converts these output signals into telephony tone signals, character codes or both. The mode of operation (data, telephony or joint) for the multifunctional keyboard **51** is preferably determined by the keyboard mode control software module **54** based on either the current requirements of the device **50**, a selection by the user of the device **50**, or possibly based on some other triggering event. The keyboard mode control software **54** may, for example, set the device **50** to a particular keyboard mode when a software application is executed on the device **50** and possibly when a particular operation is executed by the soft-

ware application. For instance, if an address book application is executed, the keyboard mode control software **54** will preferably automatically set the multifunctional keyboard **51** to a preferred mode. When entering or editing an address book entry, data mode is the preferred mode for editing or entering a name, email address, or street address field, whereas joint mode is the preferred mode for editing or entering a telephone number field. Conversely, when retrieving an address book entry, data mode is the preferred mode for retrieving a name, email address, or street address, whereas either telephony mode, joint mode or data mode may be the preferred mode for retrieving a telephone number depending upon the purpose for which it is being retrieved. For instance, if a telephone number is retrieved from an address book in order to initiate a voice communication, the number will preferably be retrieved in telephony or joint mode.

The configuration store **61** and the service store **63** located in the memory device **62** are preferably used by the keyboard mode control software **54** to determine which operational mode (data, telephony or joint) is required for a particular application. In a preferred embodiment, however, the operational mode of the keyboard **51** may also be selected or overridden by a user of the mobile device **50**. For instance, with reference to FIG. **2**, a mobile device user may preferably select or trigger a change in the keyboard mode by pressing one of the mode keys **29**.

Similarly, the letter entry or number entry modes for the keyboard embodiment **30**, **31** shown in FIG. **3**, is preferably also controlled by the keyboard mode control software **54**. Similar to the operational modes (data, telephony or joint), the number and letter entry modes may be automatically selected by the keyboard mode control software **54** based on the application currently executing on the device **50**, may be selected by the device user, or may possibly be selected by some other triggering event. For instance, if a voice communication application is executed on the device **50**, the keyboard mode control software **54** will preferably automatically set the keyboard **51** to number entry mode (and telephony or joint mode) so that a telephone number may be dialed. If the user then desires to enter the telephone number using letters, the user may preferably trigger the keyboard mode control software **54** to switch the keyboard **51** to letter entry mode. For example, with reference to FIGS. **3***a* and **3***b*, the user may be able to switch between letter and number entry modes by pressing the "NUM," "CAP," and/or "ALT" key, selecting a mode from a pull-down menu, pressing a specialized key, holding down a key for a predetermined period of time, or by some other means.

Referring again to FIG. **6**, once an operational mode (and possibly one of the letter or number entry modes) for the multifunctional keyboard **51** has been selected, either automatically or by a user, the keyboard mode control software module **54** instructs the processor **56** to convert the keyboard output signals to telephony tone signals and/or character codes. If the communication device **50** is in data or joint mode, then the keyboard output signals are converted into character codes, such as ASCII codes. If the communication device **50** is in telephony or joint mode, then telephony tone signals, such as DTMF signals, are generated. Then, as the telephony tone signals and/or character codes are generated, they may be transferred to a buffer by the processor **56** to await further processing. For instance, if a telephone number is entered into the device **50** while the keyboard **51** is in joint mode, then the character codes and DTMF tone signals for the telephone number are preferably stored in a buffer until the user initiates the call, for example by pressing a "send" key. Once the call is initiated, the DTMF tones are further processed to execute the call, and the character codes may, for example, be further processed to log the call.

The tone signal generation circuitry **52** may be used by the processor **56** to generate the telephony tone signals while the multifunctional keyboard **51** is in telephony or joint mode. In an alternative embodiment, however, digital telephony tone signals may be generated directly by the processor **56**, or by a digital signal processor. In addition to telephony tone signals, the tone signal generation circuitry **52** may also generate audible tones preferably at the option of the communication device user. The audible tones may be used, for example, to notify the user when a key is pressed on the multifunctional keyboard **51**. In alternative embodiments, the tone signal generator may generate distinctive tones when a telephony tone signal or character code is generated.

In addition to the components and software relating to the multifunctional keyboard **51**, the main module **53** also preferably includes a pair of antennas **58**, **60** (although a single antenna structure could be used), a memory device **62**, an LCD display **64**, at least one rechargeable battery **66**, a long-range RF transceiver **68**, one or more short-range RF transceivers **70**, a power supply and recharging circuit **72**, a cradle interface circuit **74**, and an auxiliary input device such as a thumbwheel **76**. The main module **53** may also include a pressure-sensitive writing tablet. Operationally, the long-range RF transceiver **68** is used to send and receive information from a long-range wireless network, and the one or more short-range RF transceivers **60** are used to send and receive information from the ear bud module **55**, and possibly from other local devices such as an RF interface cradle, or a local printer coupled to a LAN, or other types of printing or display devices.

The ear bud module **55** is preferably an RF-enabled earpiece that may be connected to (both mechanically and electrically) the main module **53** as described above. The ear bud module **55** preferably includes a microphone and a speaker **78**, a short-range wireless transceiver **80**, an antenna **82**, a rechargeable battery **84**, and possibly an integral processor **86**. Operationally, the short-range wireless transceiver **80** is used to establish an RF link between the ear bud module **55** and the main module **53**.

FIG. **7** is a flow diagram illustrating an exemplary method **90** for controlling the operational mode of the multifunctional keyboard **51** in a communication device **50**. This exemplary method **90** may, for example, be executed by the software mode control software module **54** described above. In step **92**, the communication device **50** is idle. The device **50** preferably remains idle until the processor **56** receives a trigger in step **94**. The trigger may, for example, be initiated by an unprocessed key stroke, the activation of a switch, an incoming message, an alarm condition, the activation of a software application, or any other type of event that may be detected by the device **50**. For instance, the multifunctional keyboard **51** may include a specialized key that triggers a keyboard mode change, or a mode change may be automatically triggered by the detection of some event such as the activation of a software application or a selection by the user of the device.

Once a mode change has been triggered in step **94**, the type of service (data, telephony or joint) required by the device **50** is determined in steps **96** and **100**. The required service may be determined, for example, by accessing the service store **63** locally maintained in a memory location **62** on the device **50**. The service store **63** preferably includes a log indicating the type of service required by each software application on the device **50** and also preferably includes a default service. For the purposes of the illustration shown in FIG. **7**, the default service is the data mode. It should be understood, however,

that either the telephony mode or the joint mode could also be the default service for the mobile device **50**. In a preferred embodiment, the system also accesses the configuration store **61** maintained in the memory location **62** to determine if a preferred mode has been selected for a particular application or triggering event. The configuration store **61** preferably includes user configurable preferences relating to the modes of operations. For instance, the configuration store **61** may indicate that the joint mode is preferred when the communication device **50** connects to a particular telephone number or IP address.

In step **96**, the system determines whether the software application currently operating on the device (or other triggering event) requires the multifunctional keyboard **51** to operate in joint mode. If so, then the multifunctional keyboard **51** is set to joint mode in step **98**. Otherwise, the device **50** determines whether telephony mode is required in step **100**. If the current software application (or other triggering event) requires telephony mode, then the keyboard **51** is set to telephony mode in step **102**. If neither joint mode nor telephony mode are required, however, then the multifunctional keyboard **51** is set to data mode, its default mode of operation, in step **104**. The modes of operation are detailed below with reference to FIG. **8**.

While the multifunctional keyboard **51** is in a particular operational mode, an asynchronous mode change may preferably be initiated upon the receipt of an additional trigger. This type of mode change is asynchronous in the sense that the change may preferably be initiated at any point during the operational modes described below with reference to FIG. **8**. Asynchronous mode changes are illustrated in FIG. **7** by the dotted lines from the three operational modes (steps **98**, **102** and **104**) returning to step **94** at which a trigger is received. If no asynchronous mode change is received, however, the keyboard **51** preferably remains in the same operational mode until the currently executing software application completes its operations, at which point the system returns to an idle state at step **92**.

In a preferred embodiment, more than one application may be running on the device **50** at the same time, possibly requiring concurrent operation of more than one keyboard mode. For instance, if several applications are executing on the device **51**, one application may be in the foreground (the active application) while the other applications are in the background (the idle applications). In this instance, the multifunctional keyboard **51** will preferably operate in the mode associated with the foreground application. Then, as the device user (or the device itself) switches from the foreground application to an idle application, an asynchronous trigger is preferably generated to change keyboard modes. Preferably, before the device **50** switches from one application and associated keyboard mode to another, the current mode associated with the foreground application is stored in the service store **63**. Then, when the idle application returns to the foreground and becomes active, the stored keyboard mode associated with the application is detected from the service store **63**.

FIG. **8** is a flow diagram illustrating the exemplary modes of operation **110** for the multifunctional keyboard **51**. In step **112**, the device **50** enters a keyboard mode, such as the joint mode, telephony mode or data mode. Then, when a device user presses a key on the multifunctional keyboard **51** (step **114**), the system **50** preferably determines whether a user notification function has been enabled in step **116**. The user notification function may preferably be configured by the device user to generate an audible tone as a key is pressed. To determine the user notification configuration, the system **50** preferably detects one or more notification flags set by the user and stored in the configuration store **61**. Preferably, notification flags may be stored in the configuration store **61** to either enable or disable the notification function for the data, telephony and joint modes. If the notification function has been enabled for the current keyboard mode, then the device **50** generates an audible tone in step **118**. In a preferred embodiment, the audible tone generated in step **118** is different for each keyboard mode, thus enabling the device user to determine the current mode.

In step **120**, the device **50** generates a character code and/or telephony tone signal corresponding to the key pressed by the user and a corresponding keyboard output signal from the multifunctional keyboard **51**. As described above, the signal generated in step **120** depends upon the operational mode of the multifunctional keyboard **51**. If the multifunctional keyboard **51** is in joint mode, then the system **50** generates both a character code and a telephony tone signal in step **120**. If the multifunctional keyboard **51** is in telephony mode, then the system **50** generates a telephony tone signal. If the multifunctional keyboard **51** is in data mode, then a character code is generated. Once the appropriate character and/or telephony tone signal has been generated in step **120**, the system **50** determines whether the current application or other triggering event requiring the current keyboard mode is complete in step **122**. If the application is complete, then the system exits its current keyboard mode in step **124** and returns to an idle state. Otherwise, the system **50** remains in the current mode and awaits another keystroke at step **114**. As was described above with reference to FIG. **7**, however, asynchronous mode changed may occur from within any step of FIG. **8**.

In addition to the embodiments described above with reference to FIGS. **1-8**, additional embodiments are contemplated which allow the operations of the multifunctional keyboard to be carried out on a lower system level without need for an actual keyboard or a telephony tone signal generator. For example, a communication device may include a translation mode wherein the mode control software translates key codes to telephony signals, and the key codes are provided by voice recognition software recognizing keys spoken by a user, or, alternatively, the key codes being provided from storage. In such an embodiment, the mode control software preferably translates input character codes to generate telephony signals and/or output character codes, the input character codes being interpreted as if they were generated by use of a multifunctional keyboard, thus enabling the communication device to be easily adapted to a variety of sources of input characters of which a keyboard is but one example.

This written description uses examples to disclose the invention, including the best mode, and also to enable any person skilled in the art to make and use the invention. The patentable scope of the invention is defined by the claims, and may include other examples that occur to those skilled in the art.

We claim:

1. A communication device, comprising:

twenty-six keys that are each labeled with a different letter of the alphabet and are each assigned a number;

the device being configured in a joint mode, for each key pressed by a user, to simultaneously generate both a telephony tone signal corresponding to the number assigned to the pressed key and a character code corresponding to the letter assigned to the pressed key,

wherein the numbers 2-9 are assigned respectively to keys A-C, D-F, G-I, J-L, M-O, P-S, T-V, and W-Z.

2. The device of claim **1**, wherein the keys are arranged in a QWERTY configuration.

3. The device of claim 1, wherein the device is further configured to output, for each key pressed by a user, a character code signal corresponding to the pressed key.

4. A communication device comprising:

twenty-six keys that are each labeled with a different letter of the alphabet and are each assigned a number;

the device being configured in a joint mode to simultaneously generate both a telephony tone signal corresponding to the number assigned to each key pressed by a user and a character code signal corresponding to the letter assigned to each key pressed by a user,

wherein the numbers 2-9 are assigned respectively to keys A-C, D-F, G-I, J-L, M-O, P-S, T-V, and W-Z.

5. The device of claim 4, wherein the keys are arranged in a QWERTY configuration.

6. The device of claim 4, wherein the numbers are communicated through telephony tone signals.

7. The device of claim 4, wherein the numbers are communicated through a display of the device.

8. The device of claim 4, wherein the device has a first mode of operation in which the device communicates the numbers assigned to the pressed keys and a second mode of operation in which the device communicates the letters labeled on the pressed keys.

9. The device of claim 8, further comprising a mode key in which the user can switch from the first mode to the second mode.

10. The device of claim 8, wherein the device is configured to indicate the mode of operation.

11. A method of operating a multifunctional keyboard for a communication device, comprising the steps of:

providing twenty-six keys that are each labeled with a different letter of the alphabet and are each assigned a number; and

in a joint mode simultaneously generating both a telephony tone signal corresponding to the number assigned to each key pressed by a user and a character code signal corresponding to the letter assigned to each key pressed by the user,

wherein the numbers 2-9 are assigned respectively to keys A-C, D-F, G-I, J-L, M-O, P-S, T-V, and W-Z.

12. The method of claim 11, wherein the numbers are communicated through telephony tone signals.

13. The method of claim 11, wherein the numbers are communicated through a display of the device.

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